

REMARKS

Claim 7 has been amended and new claims 33-65 have been added to particularly point out and distinctly claim the subject matter of the invention. The amendments and the newly added claims are fully supported by the specification as originally filed. Specifically, the newly added claims are at least supported by Figures 1-4, 6, 9-10, and their detailed descriptions. Claims 1-6, and 8-32 have been cancelled.

The application is directed to a non-volatile optical system for recording and reading information, based on reorientation of an isomerizable material included in a storage medium. In an embodiment, the system uses two light sources and a storage medium which includes a polymer material doped with isomerizable azobenzene molecules. Azobenzene has a trans and a cis isomer. The trans isomer is a stable isomer that can isomerize to the cis isomer by absorbing blue light. The cis isomer can isomerize to the trans isomer by either thermal relaxation or by absorbing red light. One of the two light sources emits coherent light with a wavelength band around red wavelength, and the other light source emits light with a wavelength band around blue wavelength. The system may first pre-irradiate the storage medium with circularly polarized light from the blue light source, causing the isomers in the storage medium to be randomly oriented in different directions.

During recording, the system irradiates the storage medium with patterned s-polarized light from the red light source and uniform p-polarized light from the blue light source. The pattern of the light from the red light source is representative of the information to be recorded and includes dark fringes in a first set of locations and bright fringes in a second set of locations. The p-polarized blue light causes the storage medium to essentially include trans or cis isomers that are essentially perpendicular to the p-polarization. In the bright fringes, the s-polarized light isomerizes cis isomers oriented perpendicular to the p-polarization to trans isomers oriented perpendicular to the p-polarization. Next, the system removes the irradiation and the cis isomers in the dark fringes thermally relax to randomly oriented trans isomers. Thus, in the first set of locations substantially all isomers are trans isomers perpendicular to the p-polarization, and in the second set of locations some isomers are trans isomers perpendicular to the p-polarization and other isomers are randomly oriented trans isomers.

The system reads the information recorded in the storage medium by irradiating it with uniform s-polarized light from the red light source. This s-polarized light diffracts differently off

of the first set of locations and the second set of locations, due to the presence of the randomly oriented trans isomers in the second set of locations. Reading the information with s-polarized light from the first light source does not destroy the contrast in orientation of isomers in the first set of locations and the second set of locations.

Claims Rejections – 35 USC § 112

3. Claims 9-11 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

Claims 9-11 have been cancelled, obviating the rejection.

Claims Rejections – 35 USC § 102

6. Claims 7-11, 23-27 have been rejected under 35 U.S.C. § 102(a) as being fully anticipated by Jager et al., “Bicolor surface reliefs in azobenzene side chain polymers” Appl. Opt., Vol. 40(11), pp. 1776-1778 (04-2001).

Jager presents “results of experiments with two-color holography on an azobenzene polymer” (Abstract). Jager’s system discloses glass slides coated with Azobenzene side-chain polymers (SCP) (p. 1776, emphasis added). Jager inscribes the film with two s-polarized beams from a Coherent 899-type dye laser at 645 nm. Jager also illuminates the film homogeneously with an argon-ion laser beam at 488 nm that was either s or p polarized (id.) As a result, Jager observes a surface grating resulting from periodic surface reliefs (Abstract, second column p. 1777, Fig. 4).

Applicants submit that Jager does not disclose, teach, or suggest all of the elements recited in claim 7 as amended. Jager, for example, does not teach or suggest “a storage medium comprised of a polymer material doped with a plurality of azobenzene molecules”, as recited in amended claim 7. Instead Jager uses SCP. In addition, Jager’s storage medium lacks a

storage medium forming a non-volatile orientation grating at a temperature below a glass transition temperature of the polymer material, the storage medium including the polymer material doped with the plurality of azobenzene molecules that in the first plurality of locations are trans isomers oriented essentially perpendicular to the p-polarization, and in the second plurality of

locations comprise of the first subset that are trans isomers oriented essentially perpendicular to the p-polarization and the second subset that are trans isomers oriented randomly

as further recited in amended claim 7. Similar limitations are recited in the newly added independent claims 42, 49, and 59. In contrast, in Jager's system, the azobenzene molecules are pendant chromophores attached to the polymer, and can only form a surface grating resulting from periodic surface reliefs (Abstract, right column on p. 1777, Fig. 4). Jager states that "*change of the refractive index by chromophore reorientation is small*" (right column on p. 1777).

Newly added claims 33-65 include similar limitations. Thus, Applicants contend that at least for the above reasons, amended claim 7, as well as the newly added claims are patentable over Jager. Rejected claims 8-11, and 23-27 have been cancelled.

Claims Rejections – 35 USC § 103

7. Claims 7-15, 21, and 23-27 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Jager, in view of Wu et al., "Transient biphotonic holographic grating in photoisomerizative azo materials", Phys. Rev. B, Vol. 57(7), pp. 3874-3880 (02/1998).

Wu discloses a biphotonic holographic grating. Wu's system discloses slides coated with either PMMA or PVA polymers doped with mono-azobenzene molecules (col. 2, p. 3876). Wu irradiates the film with a short-wavelength non-coherent light from Hg light source and a long-wavelength coherent light from a HeNe laser. (col. 2, p. 3874). As a result, Wu reports a transient [i.e. volatile] grating, based on redistribution of the cis isomers (Abstract, col. 2, p. 3875).

Applicants contend that the teachings of Wu can not be combined with those of Jager. Jager's system uses SCP and is based on changes in surface reliefs. Wu, on the other hand, does not use SCP and is based on formation of volatile redistribution or population gratings (Abstract, col. 2, p. 3875 and col. 2, p. 3878). Further, Wu specifically teaches away from using a "*second light source [that] is p-polarized,*" as recited in amended claim 7. For Wu's population grating system, "*the polarization states of the Ar+ laser do not effect the signal intensity significantly*" (col. 2, p. 3879), and even the p-polarized short wavelength light has the lowest efficiency compared to other polarizations (FIG. 7 and col. 1, p. 3879).

Further, Wu does not supply what Jager is missing. For example, Wu's system lacks

storage medium forming a non-volatile orientation grating at a temperature below a glass transition temperature of the polymer material, the storage medium including the polymer material doped with the plurality of azobenzene molecules that in the first plurality of locations are trans isomers oriented essentially perpendicular to the p-polarization, and in the second plurality of locations comprise of the first subset that are trans isomers oriented essentially perpendicular to the p-polarization and the second subset that are trans isomers oriented randomly

as recited in amended claim 7 (emphasis added). Similar limitations are recited in the newly added independent claims 42, 49, and 59. Instead, Wu teaches a volatile population grating (Abstract, col. 1, p. 3875 and col. 1, p. 3878).

Newly added claims 33-65 include similar limitations. Thus, Applicants contend that at least for the above reasons, amended claim 7, as well as the newly added claims are patentable over Jager and Wu. Rejected claims 8-15, 21, and 23-27 have been cancelled.

8. Claims 7-15, 21, and 23-27 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Jager, in view of Wu, further in view of Fei et al., "Biphoton holographic storage in methyl orange and ethyl orange dyes", Opt. Lett., Vol. 19(6), pp. 411-413.

Fei discloses a study of a two-photon holographic recording. Fei's system uses PVA films sensitized with the azo dyes Methyl Orange and Ethyl Orange. Fei irradiates the film with an arbitrarily polarized beam from a 514.5 nm argon-ion laser, as well as three vertically polarized beams generated by a 632.8 nm He-Ne laser (p. 411). As a result, Fei observes an unstable population grating that is due to a photochemistry triplet-triplet transition (Abstract, col. 1, p. 412).

Applicants contend that Fei can not be combined with Jager. Jager's system uses SCP and is based on changes in surface reliefs, while Fei does not use SCP and is based on formation of unstable isomerization grating (Abstract).

Further, Fei does not supply what Jager and Wu are missing. For example, Fei's system lacks

storage medium forming a non-volatile orientation grating at a temperature below a glass transition temperature of the polymer material, the storage

medium including the polymer material doped with the plurality of azobenzene molecules that in the first plurality of locations are trans isomers oriented essentially perpendicular to the p-polarization [of the blue light], and in the second plurality of locations comprise of the first subset that are trans isomers oriented essentially perpendicular to the p-polarization and the second subset that are trans isomers oriented randomly

as recited in amended claim 7 (emphasis added). Similar limitations are recited in the newly added independent claims 42, 49, and 59. Instead, in Fei's system the green beam is not polarized and what is formed is a weak isomerization grating based on a photochemistry triplet-triplet transition (Abstract, pp. 412 and 413).

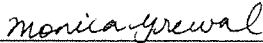
Newly added claims 33-65 include similar limitations. Thus, Applicants contend that at least for the above reasons, amended claim 7, as well as the newly added claims are patentable over Jager, Wu and Fei. Rejected claims 8-15, 21, and 23-27 have been cancelled.

In view of the above amendment, Applicants submit that the pending application is in condition for allowance, and such action is respectfully solicited.

A petition for a three-month extension of time accompanies this response, and the Commissioner is authorized to charge the fee required for this extension to Deposit Account No. 08-0219, under Order No. 1823430.00121US1 from which the undersigned is authorized to draw. No other fees are believed due at this time. However, please charge any fees, or credit any overpayments, to Deposit Account No. 08-0219, under Order No. 1823430.00121US1.

Respectfully submitted,

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Monica Grewal
Registration No.: 40,056
Attorney for Applicant(s)

Wilmer Cutler Pickering Hale and Dorr LLP
60 State Street
Boston, Massachusetts 02109
(617) 526-6000 (telephone)
(617) 526-5000 (facsimile)